Technical Report 841

Application of Key Position Analysis to the Advanced Field Artillery System (AFAS)

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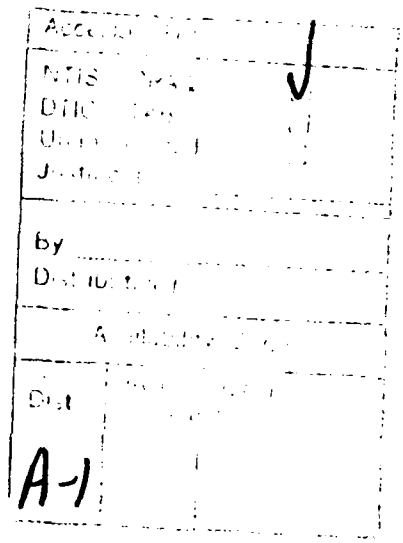

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This project applied the Key Position Analysis (KPA) methodology to the position of chief of section for the Advanced Field Artillery System (AFAS). The goal was to determine if new aptitudes or skills will be required by the section chief because of the changing role of that position in the AFAS. A series of scenarios were developed to establish the responsibilities required of the section chief during operations of the system under the dispersed battlefield concept. Appropriate responses were developed for each scenario from Army Training and Evaluation Program (ARTEP) tasks and other sources. Knowledge, skill, ability, and physical (KSAP) requirements were specified based on Military Occupational Specialty (MOS) requirements for soldiers who now perform those or similar tasks. The requirements were analyzed to recommend the appropriate MOS and grade level for the AFAS section chief. The recommendation was that the same MOS and grade currently assigned to section chief of the M109A2/A3 Self-propelled Howitzer, 13B30, be assigned to the Section Chief of the AFAS. However, the persons in this position will require training in tactical (Continued)

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leadership and decision making. These skills are taught in the Advanced Noncommissioned Officers Course (ANCOC), usually attended after the 13B30 has become a section chief and should be moved from ANCOC to BNCOC (Basic Noncommissioned Officers Course), which is usually attended before a 13B becomes a section chief. The issue of the availability of sufficient numbers of soldiers promotable to section chief is also discussed.

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FOREWORD

During concept development, the Advanced Field Artillery System (AFAS), combat developers at the U.S. Army Field Artillery School (USAFAS), Fort Sill, Oklahoma, saw the need to determine how the role of the Section Chief might change under the new system. The design for AFAS requires the capability to operate in an autonomous or semi-autonomous manner under the dispersed battlefield concept. This independence from a battery position places greater responsibility on the section chief for leadership, combat initiative, and crew safety. These increased requirements may have implications for selection and preparation for the section chief position.

A letter of agreement (LOA) between the Directorate of Combat Developments, USAFAS, and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) was entered into and signed in January 1987. This LOA called for research tasks to be undertaken by ARI in support of the Training and Doctrine Command System Manager-Cannon (TSM-Cannon) office upon mutual agreement. The first such task was an examination of the AFAS section chief duties.

This research determined changes in section chief duties required for AFAS, new aptitudes and skills needed to perform these duties successfully, and staffing possibilities within the present Army personnel structure. The methods developed for Key Position Analysis (KPA) also may be useful as MANPRINT (Manpower and Personnel Integration) tools for examining manpower, personnel, and training issues affecting leadership and decision-making positions for other new weapon systems.

A draft report of this effort was delivered and briefed to the TSM-Cannon on 27 September 1988.

The results of this project will be used in design and training for AFAS.

EDGAR M. JOHNSON
Technical Director

APPLICATION OF KEY POSITION ANALYSIS TO THE ADVANCED FIELD ARTILLERY SYSTEM (AFAS)

EXECUTIVE SUMMARY

Requirement:

This research examines how the role of the section chief will change from the present M109A2/A3 self-propelled howitzer section to the Advanced Field Artillery System (AFAS) section to determine whether new aptitudes or skills are required and whether the role change will have an manpower, personnel, or training implications for the section chief position.

Procedure:

Scenarios were developed to establish the leadership and decision-making responsibilities required of the section chief during operation of the new system under the dispersed battlefield concept. The section's appropriate responses to each situation were identified, mainly from tasks enumerated in the Army Training and Evaluation Program (ARTEP) for the Field Artillery Cannon Battery. Next, a list of tasks the section chief would have to perform for each crew response was assembled. The knowledge, skill, ability, and physical (KSAP) requirements necessary to learn and perform these tasks were specified based on the Military Occupational Specialty (MOS) requisites and skill qualifications of soldiers now performing each task on fielded systems. The KSAP requirements were analyzed to recommend the appropriate MOS and grade level for an AFAS section chief and to derive manpower, personnel, and training implications.

Findings:

The AFAS section chief will have considerably increased responsibility for leadership and decision making compared to the M109A2/A3 section chief, largely because the AFAS will operate independent of a battery position under the dispersed battlefield concept. Meeting these responsibilities will require many of the skills that M109A2/A3 section chiefs now learn only after they have been selected as candidates for battery-level positions. If this tactical and decision-making training could be provided earlier, M109A2/A3 section chiefs generally would be qualified for the position of AFAS section chief. The same MOS and skill

level, 13B30, that applies to the M109A2/A3 section chief would be equally appropriate to the AFAS section chief.

No other MOS matches the skill and experience requirements as well as a M109A2/A3 section chief. The size of the gap between the qualifications needed as an M109A2/A3 section chief and those needed as an AFAS section chief also would not justify establishing a new MOS for AFAS section chief. The most expeditious way of providing more timely training in tactical and decision-making skills to AFAS section chief candidates would be to move this instruction from the Field Artillery Advanced Noncommissioned Officer's Course (ANCOC), in which it is now offered, to the Basic Noncommissioned Officers Course (BNCOC).

Other issues identified in this report include the availability of sufficient numbers of soldiers promotable to section chief, the difficulty many soldiers have in becoming proficient in electronics tasks required for new systems such as AFAS, and the need to establish additional criteria for advancement to the position of section chief for the AFAS. A substudy, reported in Appendix A, found that the three-man howitzer crew proposed for AFAS is feasible if robotic equipment is provided to facilitate loading and assistance is available during ammunition transfer.

Utilization of Findings:

The methods developed for Key Position Analysis (KPA) successfully addressed the staffing of a leadership and decision-making position for a new weapon system. The approach can be used early in the concept development phase and requires little original data collection. The methods are recommended for MANPRINT (Manpower and Personnel Integration) efforts concerned with positions involving off-equipment responsibilities and tasks.

APPLICATION OF KEY POSITION ANALYSIS TO THE ADVANCED FIELD ARTILLERY SYSTEM (AFAS)

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APPLICATION OF KEY POSITION ANALYSIS TO THE ADVANCED FIELD ARTILLERY SYSTEM (AFAS)

Overview

This report presents the results of a Key Position Analysis (KPA) applied to the position of Section Chief for the Advanced Field Artillery System (AFAS). The projected duties of the AFAS Section Chief are compared to the current duties of the M109A2/A3 Section Chief and other reference positions to assess the extent of role change involved in transitioning to the new system. The qualifications necessary for an assignment to the new position are determined and an appropriate MOS (Military Occupational Specialty) and grade level for the AFAS Section Chief are recommended. Finally, the AFAS Section Chief position is examined with respect to its implications for demands on manpower, personnel and training resources. This information should help AFAS combat developers anticipate and prepare for the impact of the new system.

This report is concerned primarily with the findings from the Key Position Analysis research. Other aspects of this research are presented in two companion reports. Development of the Key Position Analysis (KPA) Methodology contains a detailed description of the development of the KPA methodology, an analysis of the experience gained in applying this new technique to AFAS, and an assessment of the likely role of KPA in examining MANPRINT (Manpower and Personnel Integration) issues during the early stages of the weapon system acquisition process. Procedural Guide for Key Position Analysis (KPA) presents step-by-step procedures for conducting a KPA that were revised and refined using the experience obtained from this application to AFAS.

This research was initiated early in the concept exploration phase of the AFAS design and procurement program. During the course of the research, a decision was reached to discontinue AFAS as a new weapon start but to continue system development toward this goal through a series of block improvements to the M109 self-propelled howitzer (SPH) under the howitzer improvement program (HIP). Thus, while the features planned for AFAS now will be introduced incrementally, the changes in the role of the Section Chief examined during this research will apply equally to the HIP howitzer operating under the dispersed battlefield concept.

Appendix A to this report briefly describes a substudy undertaken in conjunction with the KPA. The substudy was designed to explore the implications of reducing the size of the howitzer crew to only three members, as has been proposed for AFAS.

Introduction

To meet the force integration and future battlefield requirements identified in Army 21, the Army must develop and deploy more capable and technologically innovative weaponry. The 1980 Fire Support Mission Area Analysis (FSMAA) and Mission Element Need Statement (MENS) address current deficiencies in the combat capability of the Field Artillery and its M109 self-propelled howitzer. The ongoing Howitzer Extended Life and Howitzer Improvement Programs (HELP and HIP) were initiated to overcome some of the shortcomings in the M109's responsiveness, armament, range and survivability. However, product improvements to the M109 cannot meet all FSMAA requirements for mobility, agility and lethality while also decreasing section manpower needed for ammunition handling and other manpower intensive activities.

In response to these additional needs, the Army proposed the creation of a new self-propelled howitzer equipped with radio communication, position determining and fire control instrumentation, as well as automated loading assist equipment. This new howitzer also may be furnished with a radically new cannon using liquid propellent or electromagnetic propulsion. The resulting Advanced Field Artillery System (AFAS) is expected to meet all of the indirect fire requirements of Army 21 and the combat capability needed for the modern battlefield well into the 21st century.

The concept exploration phase of the material acquisition cycle for AFAS was begun in 1985. Although substantial progress then was made in designing the new system and achieving the technological breakthroughs needed to realize its intended capabilities, a decision was made in 1987 to suspend work on the program as a new start. Instead, a block improvement program was initiated to achieve the objectives set for AFAS incrementally, with the HIP howitzer M109A3E2/3 designated as Block 0. As now planned, the operational concepts intended for AFAS will be introduced quickly into HIP, and therefore the findings from this research will be directly applicable when that transition occurs.

In support of combat development activities for AFAS, a MANPRINT program directed at the new system was begun concurrently by the U.S. Army Field Artillery School (USAFAS) in conjunction with the Army Research Institute for the Behavioral and Social Sciences (ARI). This program had two goals: first, to identify potential MANPRINT problems that, if not eliminated, would diminish system performance for AFAS; and, second, to examine generic MANPRINT methodologies and their application early in the materiel acquisition process using AFAS as a test bed.

MANPRINT is the Army's comprehensive effort to identify manpower, personnel, training, safety, and health hazard concerns sufficiently early during weapon system development and

procurement to insure the system can be operated and maintained both effectively and efficiently. A variety of techniques have been devised to examine potential MANPRINT problems so they can be resolved before production of a new system is begun. These include Early Comparability Analysis (ECA) to determine manpower, personnel and training (MPT) resource intensive tasks now required for predecessor systems, Hardware versus Manpower (HARDMAN) Comparability Analysis to forecast MPT resource intensive tasks that will be required for a new system, and Human Factors Engineering Analysis (HFEA) to assess the human capability requirements imposed by the design of a new system.

The design concept for AFAS features a number of radical changes from the M109, the weapon it is intended to succeed. These include significant advances in fire rate and range, improvements in armor and vehicle mobility, a substantial reduction in crew size, and operations independent of a battery position under dispersed battlefield conditions. Because of the scope of these changes, the combat developers responsible for AFAS decided to proceed with a series of MANPRINT studies in support of the design concept at a very early stage of system development.

One of the areas selected for examination was how the role of the Section Chief would change from the M109 to AFAS. Although the size of the crew would be reduced, the increased complexity of the system and its more independent operations were expected to measurably increase the Section Chief's scope of responsibilities. Until these new responsibilities were identified, decisions concerning manpower, personnel and training for this position could not be made with confidence.

ARI at the same time was interested in the further development and refinement of MANPRINT methodologies. Existing methodologies all emphasize the interaction between personnel and system hardware. None were available to examine essentially non-hardware tasks such as the decisionmaking, leadership and supervisory duties that characterize the Section Chief's role. In order to examine the role of the Section Chief for AFAS, the project therefore developed a new procedure, Key Position Analysis (KPA).

Key Position Analysis

The purpose of a KPA is to identify potential manpower, personnel and training implications for the assignment, selection and instruction of operators and maintainers holding key positions in a new system. A "key position" is defined as any position that involves considerable judgment and decisionmaking in the performance of both individual tasks and crew operations needed to accomplish a mission.

Because the project developed the KPA procedure during the course of the research, the steps actually followed do not conform to the sequence recommended for future KPAs. The content of the steps in the initial and refined procedure is similar, however, and the results of this KPA probably are very similar to those that would be obtained had the more refined procedure been used. In general, a KPA relies primarily on data from military manuals and other sources that are available and familiar to combat developers. In this sense, KPA is a procedure that can be integrated into the design process for almost any new weapon system. Combat developers can use KPA to help identify changes in the responsibilities of, or additional burdens on, personnel who will perform key functions on new weapon systems. Once these have been determined, a KPA will help indicate what qualifications personnel must have for assignment to the new position, whether sufficient numbers of personnel will be available to fill these positions, and how training programs will have to be modified to prepare personnel for the new position.

Project Focus

During this research, the project confined its analysis to projected AFAS missions consistent with the dispersed battlefield concept and other operational suppositions contained in, or implied by, information in various system planning and requirements documents. Based on this information, the following assumptions were made about AFAS:

- AFAS howitzers will operate on their own, independently of a battery position.
- AFAS howitzers will have on-board crews of no more than four.
- AFAS howitzers will receive assistance from the resupply vehicle crew during fuel and ammunition resupply.
- AFAS howitzers will perform night operations consistent with opportunities to reposition the vehicle.
- AFAS howitzers will perform continuous close combat missions for periods up to 72 hours.
- AFAS howitzers will move to new positions frequently, both to lessen counterfire and to accomplish their missions.
- AFAS howitzers will be capable of a higher rate of fire and will expend ammunition more rapidly than an M109.
- AFAS howitzers will be equipped with radio voice and digital communication to both receive instructions and supply information.

- AFAS howitzers otherwise will operate similarly to an M109.

Certain operations that may be performed by an AFAS crew were excluded from the research based on instructions from the USAFAS combat developers, either because of security considerations or because the associated hardware was not far enough along in development to describe what AFAS personnel would do. These include:

- Storage, handling and firing nuclear rounds;
- Automated ammunition transloading from an armored resupply vehicle (ARV);
- Operator maintenance and troubleshooting of electronic equipment new to AFAS; and
- Operation of any radically new cannon, such as one using liquid propellant or electromagnetic propulsion, that may be adopted for AFAS.

While conducting the analysis, the project relied on these major sources of information:

FM 100-5, Airland Battle

AFAS Operational and Organizational (O&O) Plan

AFAS Use Study, including a Mission Profile (MP) and an Operational Mode Summary (OMS)

HIP Standard Operating Procedures (SOP)

HIP Operational and Organizational (O&O) Plan

ARTEP 6-100, The Field Artillery Cannon Battery

STP 6-13B14-SM, Soldier's Manual (SM) for MOS 13B

Target Audience Description (TAD) for MOS 13B.

Other helpful documentation included:

FA Battalion Table of Organization and Equipment (TOE)

Army 1990 (draft)

"The Deep Battle," Army, July 1986

"Drumbeat for Maneuver Could Muffle Firepower," Army, December 1986

"Modernization: Long Strides, Much To Do," Army, October 1986

"Getting Help and HIP," FA Journal, September/October 1985

"Shooting from the Hip," FA Journal, July/August 1986.

Combat developers at TSM (TRADOC System Manager) Cannon, USAFAS, Fort Sill, Oklahoma, continuously provided valuable information to the project on AFAS, HIP and various systems currently in inventory.

Procedures and Results

This report of findings is organized according to the nine steps recommended as the procedure for a KPA. The sequence and scope of the steps actually performed were somewhat different because the KPA methodology was still evolving. However, the order of events presented here will make the procedure easier to follow.

A detailed description of the final methodology that resulted from this effort is presented in Procedural Guide for Key Position Analysis (KPA).

Within each step, the methodology is described, the activities are summarized, and the findings are presented. Where appropriate, data appear within the text as tables. A substudy on the minimum crew size required for an AFAS howitzer is included in Appendix A.

The nine steps of the Key Position Analysis are:

Step 1. Determine the Appropriateness of Key Position Analysis

Step 2. Develop Mission Scenarios

Step 3. Select Relevant Reference Systems

Step 4. Identify the Crew Operations Required to Accomplish Each Mission Scenario

Step 5. Identify the Key Personnel and the Tasks They Must Perform for Each Crew Operation

Step 6. Prepare a Composite of Key Personnel KSAP (Knowledge, Skill, Ability and Physical) Requirements

Step 7. Recommend Appropriate MOS, Grade Level and, If Appropriate, ASI (Additional Skill Identifier) for the New Key Position

Step 8. Derive Manpower, Personnel and Training Implications Based on the KSAP Requirements

Step 9. Prepare a Research Report

Step 1. Determine the Appropriateness of Key Position Analysis

Purpose

The purpose of this step is to determine whether valid and useful research of the AFAS Section Chief position can be conducted. This is done by verifying that the AFAS Section Chief is a key position involving leadership and decisionmaking skills, that AFAS will be sufficiently different from existing systems to suggest a role change, and that adequate documentation is available on the planned employment of AFAS to establish the duties and responsibilities of the Section Chief.

Activities

The need for research of changes in the role of the AFAS Section Chief was determined by AFAS combat developers at Fort Sill and confirmed by MANPRINT representatives at the U.S. Army Research Institute for the Behavioral and Social Sciences. Therefore, when the project began, the activities in this step were focused on locating information about the operational concepts being developed for AFAS. Sources identified included the AFAS Operational and Organizational (O&O) Plan and various combat development documents. Also, a lengthy meeting was held with the system's combat developers who explained the features of the AFAS design and offered guidelines on the range of Section Chief activities that should be examined during the research.

Findings

The information on the design and projected employment of AFAS available at the beginning of the research was neither definitive nor complete, but appeared sufficient to support the conduct of a KPA. The project researched the dispersed battlefield concept and identified a number of conditions and mission assignments that would place considerable responsibility on the AFAS Section Chief. The most significant new features proposed for the AFAS, in terms of the KPA, were the reduction in crew size, the 72-hour battle scenario, and weapon operations away from a battery position. In particular, the need for continuous independent operations envisioned under the dispersed battlefield concept was recognized as a substantial change from existing doctrine. This operating concept would intensify demands on crew performance already expected due to the planned reduction in crew size and the requirement for a 72-hour period of combat. The AFAS Section Chief would need to provide greater leadership and be responsible for more decisionmaking than a comparable M109 Section Chief, and manage his section with far less direct supervision.

Step 2. Develop Mission Scenarios

Purpose

The purpose of this step is to generate a set of mission scenarios based on the new features and operating concepts being developed for AFAS. These scenarios are then used to help identify the various operations that would be performed by AFAS sections under combat conditions. The scenarios also provide a basis for confirming the project's understanding of the new weapon system's capabilities and the range of problems and mission assignments the USAFAS combat developers believe should be examined by the research.

Activities

The project's principal aim in developing the scenarios was to generate a sufficient quantity of scenarios to insure that all identified changes in operating concepts were covered. Project staff researched the dispersed battlefield concept as well as the new equipment features and operational principles being developed for AFAS. Staff also examined the mission activities of the M109 howitzer to insure that the scenarios reflected the operating concepts that are distinct to AFAS. Project staff then identified combat conditions and mission assignments to which the AFAS section might have to respond and used these as the basis for developing mission scenarios appropriate to the expected AFAS operational environment. USAFAS combat developers were consulted on several occasions while the scenarios were being developed. The combat developers also were asked to verify the final versions.

Findings

A total of 17 mission scenarios was prepared in this step. All 17 emphasize the distinctive operational characteristics of the AFAS although many represent situations that are equally applicable to M109 or HIP howitzers were they to operate under the dispersed battlefield concept. The scenarios consider only tasks performed by the crew of the weapon platform, and do not include activities of the section's armored resupply vehicle (ARV) crew.

During the scenario development process, the staff tried to identify possible problems with, or omissions from, the operating concepts that had been developed for AFAS. These intentionally were emphasized in the scenarios both to call the attention of the combat developers to them and to insure that any decisionmaking required of the Section Chief would be included in later steps of the KPA. Some of the operational problems evident at the time the scenarios were developed include:

- The ability of the section to sustain continuous operations for 72 hours with a crew of four or fewer.

- The likely need for frequent resupply of ammunition and fuel given the AFAS rate of fire and expected mobility.
- The necessary dependence of the section on land navigation skills during independent operations.
- The lack of a comprehensive maintenance concept for AFAS with respect to repairs in the field and access to spare parts.
- The ability of the section to establish a perimeter or otherwise defend itself against ground attack.
- The need for proficiency in manual mode operations in order to perform missions during periods of equipment malfunctioning.
- The limited capability to conduct night fire missions to the extent that repositioning at night would be required for defense against counterfire.
- The need for SOPs that would guide AFAS operations in case of a loss of radio communications.

The 17 scenarios developed are listed in Table 1. In retrospect, these seem to represent the full spectrum of what might be expected of an AFAS howitzer in terms of the mission assignments it might receive and the situations it might encounter, and appear to be a useful technique for determining what operations the AFAS howitzer will perform. It should be noted, however, that the project expected the scenarios to demonstrate requirements for more extensive leadership and decisionmaking on the part of the Section Chief than emerged. No conditions or mission assignments could be identified that called for considerably more discretion on the part of an AFAS Section Chief than would be expected of most M109 Section Chiefs. Although the conditions and circumstances facing an AFAS section are considerably broader than the circumstances an M109 section are likely to encounter, the AFAS Section Chief's actions will continue to be directed by the Battery, and his response to problems will be "by the book."

Table 1

Mission Scenarios

Situation No. 1. Your section is ordered to displace to arrive at its new position no later than 30 minutes from time of displacement. Your section acknowledges and you make a reconnaissance by map. Having selected your route, you direct your driver to move out. You encounter no difficulty for the first 20 minutes, but then arrive at a gorge that forces you on to a roadway leading to a built-up roadbed through a large swamp area. After you have gone several hundred yards, the roadway is blown. You check the elapsed time and see that you do not have time to retrace your route. You order the driver to move off the roadway on to the swampy ground. After moving about 25 yards the gun becomes mired down and cannot move in any direction.

Situation No. 2. Your section has continued to receive fire missions in support of the attack. Because the other guns are displacing, most of the missions have been directed to your section. You receive a FFE (Fire for Effect--no adjustment) mission with fuse VT (Variable Time--automatically explodes at a set distance above the ground). The cannoneer setting the fuses tells you that the VT fuses have been damaged and are unsafe to use. You attempt to contact the FDC (Fire Direction Center) via your voice radio net. You cannot make contact.

Situation No. 3. Your section has moved to a new position well forward in order to support the rapidly moving attack. You have been in your new position only a short time when you receive automatic weapons fire. You bring your organic weapons to bear on the attackers, only to receive heavier fire from another direction. As you attempt to return that fire, you receive a priority fire mission on your digital display.

Situation No. 4. A casualty was sustained in the automatic weapons attack above. The wounded crew member has been successfully evacuated to the rear, but no additional personnel are available for replacement. Your section now has a crew of two and is ordered to its next position, under cover of darkness, to fire a special mission.

Table 1 (continued)

Mission Scenarios

Situation No. 5. Your section is now rapidly displacing forward to support the attack. You have entered a passage in the mountains parallel to the front. You receive an emergency fire mission (Hip Shoot). Just before firing, you realize that your range to crest (mountainside to your front) will not allow you to fire the mission as computed.

Situation No. 6. You suspect that your onboard self-locating and self-orienting unit is not functioning properly. You have passed another gun position and know you can get a reciprocal lay, but to do so would place the two guns quite close in the same position. Enemy attack helicopters have been reported in the area. You receive a priority danger close (target is close to friendly troops) mission.

Situation No. 7. The attack has been moving quite rapidly. Your section is low on ammo. You need to relocate in order to support deep targets. Your ARV has been directed to meet you at your present location.

Situation No. 8. After now more than 18 hours of sustained operations, a warning light on your section's maintenance display indicates power pack oil is at danger-low point. You had checked and added power pack oil 10 minutes before at the last firing position. You don't think there is a problem. The digital display flashes a message from platoon taking you out of action due to low power pack oil.

Situation No. 9. After more than 18 hours of sustained operations and now NBC (Nuclear, Biological and Chemical) conditions, your vehicle's power is growing weak to the point where it is having difficulty changing positions. All onboard maintenance displays read "normal," but you have had several similar experiences when mud has clogged the exhaust system.

Situation No. 10. Your section has arrived at a designated resupply point, but no ARV is present to perform the resupply. You and the ARV chief both report closing on the assigned location, but neither of you can find the other.

Table 1 (continued)

Mission Scenarios

Situation No. 11. Your section encounters the surviving crew from one of the Battery's ARVs destroyed in an ambush. The gun has insufficient fuel to reach its designated POL (Petroleum, Oils and Lubricants) point, but it does have enough ammunition to continue support of current missions in place.

Situation No. 12. Your section is firing a mission. The observer sends a bold correction, but the subsequent round is still significantly in error. Battalion FDC reports the correction to you and requests firing data for the previous three rounds.

Situation No. 13. Your section is directed to its next position. Intelligence reports indicate that the area may be a chemical hazard. Nonetheless, your section must occupy it to accomplish the mission.

Situation No. 14. Your section closes on the position and prepares for action. As you occupy your position, your chemical detection alarm sounds, indicating a chemical hazard. An enemy helicopter is observed and now attempts to suppress your fire.

Situation No. 15. Your section has successfully neutralized the enemy helicopter. For security and morale purposes, Battery orders you to a hide position (safe from chemical hazards) for stand down. Operations resume at 0600 tomorrow.

Situation No. 16. The following day begins early as an artillery round lands near your position at about 0530. Your response is to take all necessary immediate action.

Situation No. 17. Your fire control mechanism cannot lay for deflection, only elevation. A spare deflection circuit board is in your PLL (prescribed load list) and you have the capability to replace it.

Step 3. Select Relevant Reference Systems

Purpose

The purpose of this step is to identify similar weapon systems that could be examined as baselines to determine where there would be differences in the operations of the new system. The operational differences between the reference systems and the AFAS then can be used to establish changes in critical crew and key position duties for the new system.

Activities

Project staff consulted extensively with combat developers at TSM Cannon, Fort Sill, to identify relevant reference systems for this research. When examining potentially relevant reference systems, the project relied on key doctrinal manuals, current military journal articles, and technical and operating manuals for artillery weapons. Field manuals for suggested reference systems were examined to identify their operational principles and the type of missions performed by each. The operational principles proposed for AFAS were then compared to those of the reference systems with respect to how each of the mission scenarios would be accomplished. This comparison resulted in identifying two major weapon systems currently in the Army inventory that have operational characteristics similar to AFAS.

Findings

The AFAS combat development team at Fort Sill suggested two crew-served weapons, the M109 155mm self-propelled howitzer (SPH) and the Multiple Launch Rocket System (MLRS) as reference systems that perform similar missions to those envisioned for AFAS. The M109 was proposed because, like AFAS, it is a self-propelled artillery piece that presumably would be replaced by AFAS. The MLRS was proposed because, like AFAS, it operates independently of a battery position and has electronic equipment for position determination and fire control similar to what will be provided for AFAS. Very early in the project, other weapon systems such as the Light Helicopter Experimental (LHX) also were considered as potential reference systems because of their independent operations and their use of sophisticated technology. However, project staff felt that Field Artillery reference systems would be more appropriate for this KPA providing, as was established, most operational characteristics of AFAS were represented.

By and large, the M109 has missions and operates under conditions similar to those for AFAS. The M109 fires at discrete targets, repositions frequently and, although it is primarily an indirect fire weapon, the M109 can be used for direct fire on a target. The MLRS, on the other hand, cannot perform direct fire. It also fires at a spread target from well behind the front line and repositions only for defensive purposes. Therefore, the MLRS is less suited to a dispersed battlefield

environment. On the other hand, the MLRS uses advanced electronic equipment not available to the M109, operates independently of a battery position, and has an onboard crew of only three, similar to the crew size proposed for AFAS.

Based on these features, project staff selected the M109 as the primary reference system for the AFAS. The MLRS was retained as a secondary reference system. Although neither has the 72-hour sustained operations proposed for AFAS, no additional reference systems were felt to be needed for the KPA.

Step 4. Identify the Crew Operations Required to Accomplish Each Mission Scenario

Purpose

The purpose of this step is to compile an exhaustive list of the crew operations and key personnel activities that would be required in response to any of the mission scenarios. This list represents a collective task database for use in identifying both key personnel tasks required during each crew operation and those tasks performed individually by key personnel but required of the section as a whole, such as Process Fire Commands.

Activities

ARTEP (Army Training and Evaluation Program) and field manuals for the M109 and MLRS reference systems were used as the primary sources of information for this step. Based on the collective tasks listed, a preliminary list of crew operations for AFAS was developed. This preliminary list was then supplemented with additional collective tasks created for this purpose that covered crew activities not addressed in either the M109 or MLRS ARTEPs. Combat developers and Subject Matter Experts (SMEs) at USAFAS reviewed the crew operations list and compared it with the mission scenarios for accuracy and completeness. During this review, the reviewers were asked to add or delete operations as appropriate to match their expectations for how an AFAS howitzer would function.

Findings

Review of the M109 ARTEP yielded 49 howitzer crew operations that might be required in response to the mission scenarios over the course of a 72-hour battle. The MLRS ARTEP was less useful because the only collective tasks from MLRS relevant to expected AFAS operations concerned the use of radio communications and position determination equipment, both of which also appear in the M109 ARTEP although at the battery rather than section level.

Of the 49 AFAS-relevant collective tasks that were identified, 21 were derived from current M109 section operations that apply directly to AFAS. These include, for example, Prepare Ammunition for Firing and Fire the Howitzer. Other tasks within

this group were ones that may be needed primarily during manual operations in degraded mode, such as Boresight the Howitzer. Tasks now performed at the battery level for the M109 comprised 27 tasks. These primarily are tasks concerned with moving and repositioning the section, with the use of radio communications, with maintenance and resupply, and with defense against attack. The 27 battery-level operations would be performed by individual AFAS howitzer crews under the dispersed battlefield concept. One last collective task, Establish and Extend Survey Control, is now performed at the battalion level for the M109. Establishing the weapon's precise position also would become a section-level responsibility for AFAS using its onboard Position Determining System (PDS).

A detailed examination of the tasks on the list suggests that there is rarely an exact parallel between tasks performed for the M109 and those that would be required for AFAS. The purposes of the tasks are quite similar but many of the procedures employed will be different. Primarily, this is due to expected changes in equipment or operating conditions. For purposes of a KPA, however, collective tasks that are more or less parallel are satisfactory and, generally, are preferred to creating new collective tasks to represent duties to be performed with the new weapon system.

After the list of 49 AFAS collective tasks was prepared, USAFAS combat developers reviewed the list to insure its accuracy and completeness with respect to both the mission scenarios and the design concept for AFAS. In this particular research, the review did not occur until after the list of Section Chief individual soldier tasks was developed, as described under the next step. Based on the project's experience, however, this review of collective tasks should occur first. The remainder of the findings for this step describe the outcomes of the review as if the review had occurred in a more timely way.

During the review, the combat developers deleted twelve collective tasks from the list as inappropriate to their understanding of how AFAS would operate. These twelve tasks were: Conduct Air Movement, Conduct an Air Assault Artillery Raid, Perform (Battery) Position Improvements, Implement Immediate Action Procedures, Reconstitute After Attack, Improve (Section) Position, Prepare Supplementary Positions, Prepare Alternate Position for Occupation, Fire a Priority Target, Fire an Assault Fire Mission, Store and Transport Ammunition and Secure Nuclear Weapons. The reasons for deleting these tasks were that air movement no longer was a planned AFAS capability, that AFAS would move too frequently to justify either position improvements or fire missions that assumed being in one position for an extended period, that position determining equipment would eliminate the need for preestablished alternate and supplementary positions, that the AFAS howitzer crew would not be responsible for ammunition handling except to put it on board and that nuclear weapon tasks should be omitted from this research. Tasks

were retained if at least some significant component of the task also would be performed by the AFAS crew, particularly if it was a task the crew would have to perform manually in case of some equipment breakdown. No collective tasks were recommended as additions to the list. Maintenance tasks that might be performed by the crew in a remote field environment were not included because the maintenance philosophy for AFAS was still under development and no lists of on-board spare parts or tools were available.

Table 2 lists the 49 operations initially identified as those to be performed by an AFAS crew during combat. Subheadings indicate the level at which that task is now performed for an M109. The twelve tasks then eliminated by the combat developers are labeled "deleted."

Table 2

AFAS Section Operations

M109 Battery Tasks

1. Conduct reconnaissance operations
2. Recover and prepare for movement
3. Perform tactical road march
4. (Deleted) Conduct air movement
5. Occupy position area
6. (Deleted) Conduct an air assault artillery raid
7. (Deleted) Perform (battery) position improvements
8. Establish and operate radio communications
9. Employ ECCM (Electronic Counter-Counter Measures)
10. Employ SIGSEC (Signal Security) techniques
11. Defend against ground attack (stationary)
12. Defend against ground attack (moving)
13. Defend against air attack (stationary)
14. Defend against air attack (moving)
15. (Deleted) Implement immediate action procedures
16. (Deleted) Reconstitute after attack
17. (Deleted) Secure nuclear weapons
18. Prepare for combat operations in NBC environment
19. Give a situation report
20. Give a shell report
21. Give NBC report
22. Report survey control points and combat information
23. (Deleted) Store and transport ammunition
24. Draw and turn in ammunition
25. Transport ammunition
26. Maintain and report ammunition information
27. Manage maintenance records
28. Repair and replace equipment
29. Maintain prescribed load list

Table 2 (continued)

AFAS Section Operations

M109 Battalion Tasks

30. Establish and extend survey control

M109 Section Tasks

31. Emplace and lay cannon
32. Determine and report site to crest range
33. Boresight the howitzer
34. Perform prefire checks
35. Prepare ammunition for conduct of fire missions
36. Lay on a planned priority target
37. (Deleted) Improve (section) position
38. (Deleted) Prepare supplementary positions
39. (Deleted) Prepare alternate positions for occupation
40. Process fire commands
41. Prepare ammunition for firing
42. Load howitzer
43. Lay for deflection and quadrant
44. Fire the howitzer
45. (Deleted) Fire a priority target
46. (Deleted) Fire an assault fire mission
47. Fire a direct fire mission
48. Unload the howitzer
49. Manage and submit records of fire and reports

Step 5. Identify the Key Personnel and the Tasks They Must Perform for Each Crew Operation

Purpose

The purpose of this step is to identify the key personnel having primary responsibility for each of the collective tasks identified in the preceding step, and the individual tasks these key personnel must perform while the crew operation is being accomplished. When the collective task is one performed by several individuals working together, the individual key personnel task is likely to be "supervise" or "direct" that activity. In some cases, however, individual key personnel tasks will include technical or procedural duties, such as Process Fire Commands. One or more individual tasks performed by key personnel are to be identified for each crew operation. The results of this step define the tasks to be performed by the key personnel; in this case, by the AFAS Section Chief.

Activities

Project staff used the Field Artillery Battery ARTEP and the MOS 13B Soldier's Manual (STP 6-13B14-SM) as the primary sources of key position soldier tasks required for the performance of each crew operation. Because all of the crew operations had been derived from the M109, this was the only reference system used. Additional ARTEPs and SMs would have been reviewed if other reference systems also were needed.

The ARTEP yielded 50 individual tasks, such as Direct Loading of the Howitzer. The Soldier's Manual yielded another 18 individual tasks, including many that require technical performance such as Adjust the Equilibrators. The project staff added four more tasks, including Direct Misfire Procedures and Assure Section Readiness, not covered either in the ARTEP or the Soldier's Manual but required for at least one of the crew operations. The total number of individual tasks was therefore 72.

Because the twelve collective tasks had not yet been eliminated by the combat developer review when this step actually was performed, the individual task list also included tasks related to these crew operations. However, not all of these individual tasks subsequently were removed from the key personnel task list. For example, even though the AFAS is not likely to remain in a position long enough to warrant position improvement efforts, and this activity was deleted from the crew operations list, the Section Chief nevertheless would have to be able to supervise section position improvement activities should this ever be desirable. On the other hand, some individual tasks, including Prepare Range Card for a Howitzer, were deleted. Although this task is performed by an M109 Section Chief in preparation for defense against ground attack, the AFAS would not remain in a given position long enough to make a range card worthwhile. As a result, thirteen individual tasks were deleted from the list following the review, leaving 59 as tasks to be performed by the AFAS Section Chief.

During the development of this list, the project staff concurrently identified the present performer of each task. Most of the tasks currently are performed by the M109 Section Chief. However, more than one performer could be identified for some of the remaining tasks. In these instances, the performers were prioritized according to the principle of closest match relative to the M109 Section Chief:

--Different grade, but same MOS;
--Different MOS, but same branch (Field Artillery);
--Different MOS, different branch;
--Position in another service;
--Not currently a U.S. military position.

Findings

The project staff compiled a preliminary list of key position tasks involved in each crew operation identified in Step 4. Excluding the 13 tasks that were deleted later, 48 of the remaining 60 tasks are AFAS Section Chief tasks currently performed by the M109 Section Chief. Ten are tasks that would be performed by the AFAS Section Chief, but currently are performed by one or more of the following personnel: Battery Commander (13E), Gunnery Sergeant (13B40), Executive Officer (13E), Fire Direction Officer (13E), First Sergeant (13Z50), Maintenance Sergeant (63D30), NBC NCO (54E20), and Organizational Maintenance FA Turret Repairer (45D10). Tasks performed by the Battery Commander, Executive Officer and Fire Direction Officer were included when they were essential to some crew operation. All of these, however, also are performed by the Gunnery Sergeant, the Chief of Firing Battery or the Fire Direction NCO in the absence of a superior officer. One task, performed by the NBC NCO, is directed by the M109 Section Chief. Another, Perform a Zero Pressure Check on the M109 Hydraulic System, currently is performed by an Organizational Maintenance FA Turret Repairer (45D10). However, the SQT (Skill Qualification Test) for 13B30 formerly included this task and, although no longer listed, all 13B30s interviewed by staff agreed the task was within 13B30 expertise as well.

The only remaining task, Submit Survey Reports and Operate PDS, is not now performed at the M109 section or battery level. Instead, the task is performed by a Field Artillery Surveyor (82C10). The task also is performed by an MLRS Crewman (13M10). This is the only task that would be required of an AFAS Section Chief that is not now performed by an MOS 13B.

The four tasks added by the Project staff do not appear on any 13B task list. All are supervisory activities now routinely performed by a 13B30 Section Chief for an M109, however.

Table 3 lists the key position tasks for an AFAS Section Chief including the 13 tasks that were deleted later. In the table, the positions performing each task are indicated. Although the potential need for entirely new tasks that an AFAS Section Chief might perform was recognized, none were required because identical or sufficiently parallel tasks already exist among the duties performed by personnel in an M109 battery, except for the position determining task.

Table 3

AFAS Section Chief Duties

Abbreviations Used:

SC = M109 Section Chief (13B30)
BC = Battery Commander
XO = Executive Officer
FDO = Fire Direction Officer
1SG = First Sergeant
GS = Gunnery Sergeant
CFB = Chief of Firing Battery
FDNCO = Fire Direction NCO
MSG = Maintenance Sergeant
MLRS = MLRS Crewman
FAS = Field Artillery Surveyor
FATR = FA Turret Repairer
BSC = Battalion Survey Chief

ARTEP-Derived Duties

	Duty	Now Performed By
1.	Conduct reconnaissance operations	BC, GS
2.	Supervise recovery and prepare for movement	SC
3.	Direct tactical road march	BC, XO, FDO, GS
4.	(Deleted) Supervise section in conduct of air movement	SC
5.	(Deleted) Supervise section during conduct of an air assault artillery raid	SC
6.	Supervise occupation of position area	SC
7.	(Deleted) Supervise battery position improvements	BC, XO, 1SG, GS
8.	Establish and operate radio communications	BC, XO, 1SG, MSG, CFB, FDNCO
9.	Employ ECCM	BC, XO, FDO, 1SG, MSG, CFB, FDNCO
10.	Employ SIGSEC techniques during radio use	BC, XO, FDO, 1SG, MSG, CFB, FDNCO

Table 3 (continued)

AFAS Section Chief Duties

11.	Direct defense against ground attack (stationary)	SC
12.	Direct defense against ground attack (moving)	SC
13.	Direct defense against air attack (stationary)	SC
14.	Direct defense against air attack (moving)	SC
15.	(Deleted) Direct implementation of immediate action procedures	SC
16.	(Deleted) Direct reconstituting after attack	XO, GS, CFB
17.	(Deleted) Direct securing nuclear weapons	SC
18.	Prepare section for combat operations in NBC environment	SC
19.	Give a situation report	XO, FDO, GS, CFB, FDNCO
20.	Give a shell report	FDO, GS, CFB, FDNCO
21.	Give NBC report	XO, FDO, GS, CFB, FDNCO
22.	Submit survey reports and combat information	FDO, GS, FDNCO
23.	(Deleted) Establish survey control	BSC
24.	Direct emplacement and lay of cannon	SC
25.	Direct emplacement and selection of reference points	SC
26.	Determine and report site to crest range	SC
27.	Direct boresighting of the howitzer	SC
28.	Perform prefire checks	SC

Table 3 (continued)

AFAS Section Chief Duties

29.	Ensure ammunition prepared for conduct of fire missions	SC
30.	Direct laying on a planned priority target	SC
31.	Supervise (section) position improvement	SC
32.	(Deleted) Direct preparation of supplementary positions	SC
33.	(Deleted) Direct preparation of alternate positions for occupation	SC
34.	Process fire commands	SC
35.	Supervise preparation of ammunition for firing	SC
36.	Direct loading of howitzer	SC
37.	Supervise laying for deflection and quadrant	SC
38.	Direct section in firing of howitzer	SC
39.	(Deleted) Supervise firing a priority target	SC
40.	(Deleted) Supervise firing an assault fire mission	SC
41.	Supervise direct fire procedures	SC
42.	Supervise unloading of howitzer	SC
43.	Manage and submit records of fire and reports	SC
44.	Supervise storage and transport of ammunition	SC
45.	(Deleted) Supervise preparation of equipment for an air assault operation	SC
46.	Supervise draw and turn in of ammunition	SC

Table 3 (continued)

AFAS Section Chief Duties

47.	Maintain and report ammunition information	SC
48.	Supervise repair and replacement of equipment	SC
49.	Manage and coordinate supply and resupply	XO, 1SG, CFB
50.	Submit survey reports and operate PDS	MLRS, FAS
	Additional Duties Added by Project Staff	
51.	Supervise preparation of vehicle for combat	SC
52.	Assure section readiness	SC
53.	Manage and conduct crew training	SC
54.	Direct misfire procedures	SC
	SM and SQT-Derived Duties	
55.	Determine site to crest and range to crest	SC
56.	Perform gunner's quadrant micrometer test	SC
57.	Perform gunner's quadrant end-for-end test	SC
58.	(Deleted) Prepare a range card for a howitzer	SC
59.	Determine that the howitzer is safe to fire	SC
60.	Compute data for a sweep and zone fire mission	SC
61.	Set and lay for quadrant using the gunner's quadrant	SC
62.	Measure quadrant with gunner's quadrant	SC

Table 3 (continued)

AFAS Section Chief Duties

63.	Issue fire order for direct fire mission	SC
64.	Maintain DA Form 2408-4 (Weapon Record Data)	SC
65.	Update and maintain technical publications	SC
66.	Prepare a load plan (fill out DA Form 2491-R)	SC
67.	Determine howitzer muzzle velocity using M90 chronograph	SC
68.	Process fire missions using gun display unit	SC
69.	Perform land navigation and map reading	SC
70.	Verify PMCS (Preventive Maintenance Checks and Services) on M109 howitzer	SC
71.	Adjust the equilibrators on the M109	SC
72.	Perform a zero pressure check on the M109 hydraulic system	FATR with SC

Step 6. Prepare a Composite of Key Position KSAP Requirements

Purpose

The purpose of this step is to establish a composite of the knowledge, skill, ability and physical (KSAP) requirements for the AFAS Section Chief. In the next step, this composite will be assessed against the KSAP requirements for existing positions to identify the most logical incumbent, in terms of MOS and grade level, for the position of AFAS Section Chief or, if there is no appropriate match, to recommend an MOS and grade level for the AFAS Section Chief.

Activities

In order to accomplish this step, the project staff adapted and simplified a mix of existing methodologies that have been used to determine KSAP requirements. What was wanted was a

methodology that could be employed without extensive data collection and yet, at the same time, was precise enough for the purposes of a KPA and for the decisions about the key position that would have to be made. In this approach:

- Knowledge and Skill requirements are merged into one category. They are represented by a combination of the competencies assumed present in a typical high school graduate and the competencies represented by the common and MOS-specific tasks a soldier at a given skill level has learned in Army basic training, advanced individual training (AIT), skill qualification training, and NCO development training.

- Ability requirements are represented by the Armed Services Vocational Aptitude Battery (ASVAB) aptitude profile, or composite qualification predictor, cited for that MOS in Army Regulation 611-201, along with any special abilities noted that determine qualification for that MOS.

- Physical requirements are represented by the Army Profile Serial (or PULHES, encompassing physical stamina, upper extremities, lower extremities, hearing, eyes and psychological profile), the MEPSCAT (Military Enlistment Physical Standards Capacity Test) physical demands rating, and color vision or other special physical requirements specified for the MOS in Army Regulation 611-201.

The 62 AFAS Section Chief tasks identified in the preceding step were examined to determine the fewest MOSs and grade levels needed to represent all tasks. Because the largest proportion, 48 of the 59 tasks remaining after USAFAS combat developer review, now are performed by the M109 Section Chief, a 13B30, this position was selected first. The next most prevalent positions were Chief of Firing Battery and Gunnery Sergeant, who both are 13B40s. Although the 10 tasks performed by these personnel also are performed by other positions, particularly by battery officers, they are tasks included among the skills presumed present among 13B40s. The one last task is performed by neither 13B30 nor 13B40 but, in slightly different versions, by a 13M10 (MLRS Crewman) and an 82C10 (Field Artillery Surveyor). For the purposes of the KPA, both of these were retained in the list for the following stage of the analysis.

Next, the KSAP requirements represented by each of these MOSs and skill levels were identified. This yielded a core list of KSAP requirements for the AFAS Section Chief. After this core list was prepared, the requirements were reviewed by comparing them to the list of AFAS Section Chief tasks to determine whether any essential KSAP requirements were missing. No omitted KSAP requirements were identified.

Findings

The aptitude and physical requirements for all but one task were those of 13B30 and 13B40. The aptitude profile for MOS 13B is FA (Field Artillery), which represents a combination of aptitudes in Arithmetic Reasoning, Computation Speed, Mathematical Knowledge, and Mechanical Comprehension. As to physical requirements for MOS 13B, the PULHES rating is 222221, the physical demands rating is Very Heavy (VH), and the color vision requirement is red-green. No other special aptitude or physical requirements are specified in Army Regulation 611-201.

The one remaining task not performed by either a 13B30 or a 13B40, Submit Survey Reports and Operate PDS, is performed by two positions, 13M10 and 82C10, that have different aptitude and physical requirements. Although 82C has different aptitude and more stringent physical requirements than 13B, those of 13M closely parallel 13B: a PULHES rating of 222221, a physical demands rating of Moderately Heavy (MH), and red-green color vision. The aptitude indicator for 13M is OF (Operations of Food), which represents a combination of aptitudes in Numerical Operations, Automotive and Shop, Word Knowledge, Paragraph Comprehension, and Mechanical Comprehension.

The knowledge and skill requirements, again for all but this one task, consist primarily of those expected to be present in a 13B30 or 13B40 because of his training and experience. Table 4 repeats the list of 61 AFAS Section Chief tasks remaining after the review in Step 5 and identifies the KSAPs required for each.

Table 4

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Conduct reconnaissance operations	M109 Gunnery Sergeant (GS) 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise recovery and prepare for movement	M109 Section Chief (SC) 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct tactical movement	GS 13B40	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Supervise occupation of position area	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Establish and operate radio communications	M109 Chief of Firing Battery (CFB) 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Employ ECCM	CFB 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Employ SIGSEC techniques during radio use	CFB 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Direct defense against ground attack (stationary)	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct defense against ground attack (moving)	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct defense against air attack (stationary)	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct defense against air attack (moving)	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Prepare section for combat operations in NBC environment	SC 13B30 (54E20 assists)	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Give a situation report	GS 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Give a shell report	GS 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Give NBC report	GS 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Submit survey reports and combat information	GS 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Direct emplacement and lay of cannon	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct emplacement and selection of reference points	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Determine and report site to crest range	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct boresighting of the howitzer	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Perform prefire checks	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Ensure ammunition prepared for conduct of fire missions	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct laying on a planned priority target	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise (section) position improvement	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Process fire commands	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise preparation of ammunition for firing	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct loading of howitzer	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise laying for deflection and quadrant	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct section in firing of howitzer	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise direct fire procedures	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Supervise unloading of howitzer	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Manage and submit records of fire and reports	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise storage and transport of ammunition	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise draw and turn-in of ammunition	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Maintain and report ammunition information	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise repair and replacement of equipment	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Manage and coordinate supply and resupply	CFB 13B40	A=FA P=222221+VH+red-green color discrimination Other: none
Supervise preparation of vehicle for combat	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Assure section readiness	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Manage and conduct crew training	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Direct misfire procedures	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Determine site to crest and range to crest	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Perform gunner's quadrant micrometer test	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Perform gunner's quadrant end-for-end test	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Determine that the howitzer is safe to fire	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Compute data for a sweep and zone fire mission	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Set and lay for quadrant using the gunner's quadrant	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Measure quadrant with gunner's quadrant	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Issue fire order for direct fire mission	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Maintain DA Form 2408-4 (Weapon Record Data)	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Update and maintain technical publications	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Prepare a load plan (fill out DA Form 2491-R)	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Determine howitzer muzzle velocity using M90 chronograph	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Process fire missions using gun display unit	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Perform land navigation and map reading	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Verify PMCS on M109 howitzer	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none
Adjust the equilibrators on the M109	SC 13B30	A=FA P=222221+VH+red-green color discrimination Other: none

Table 4 (continued)

KSAP Requirements for Section Chief Tasks

TASK	REFERENCE POSITION	APTITUDE AND PHYSICAL PROFILES
Perform a zero pressure check on the M109 hydraulic system	SC 13B30 (also performed by 45D10)	A=FA P=222221+VH+red-green color discrimination Other: none
Submit survey reports and operate PDS	MLRS Crewman 13M10 (and by)	A=OF P=222221+MH+red-green color discrimination Other: none
	Field Artillery Surveyor 82C10	A=ST P=222221+VH+red-green color discrimination Other: none

Step 7. Recommend Appropriate MOS, Grade Level and, If Needed, ASI for the New Key Position

Purpose

The purpose of this step is to analyze the composite of KSAP requirements in order to identify an MOS and grade level that most closely reflects the qualifications needed for the position of AFAS Section Chief. Alternatively, if no reasonable match can be identified, a new MOS might be proposed. This determination then is used to assess the extent of available manpower for the position, to evaluate whether present personnel are likely to have the needed qualifications, and to establish whether additional training may be necessary.

Activities

Project staff reviewed the results of the preceding step to determine the degree of overlap between the core reference position, 13B30, and the other reference positions. Tasks performed by incumbents in alternate reference positions were analyzed on the basis of the KSAP requirements involved in learning and performing each task to determine whether competency depended on KSAP requirements that were unique to the alternate reference position. Based on this analysis, the project staff prepared recommendations as to the MOS appropriate to the AFAS Section Chief position, the grade level for that position, and whether an ASI (Additional Skill Identifier) should be considered for the position.

Findings

Of the 59 tasks identified for the AFAS Section Chief, 48 currently are performed by a 13B30. Ten of the 11 remaining tasks currently are performed by a 13B40. These MOSs share the same basic aptitude and physical requirements. The 13B40, however, performs tasks that only are expected at skill level 4. Also, in terms of his qualifications, a 13B40 generally has more years of service as well as a more positive DA review record. Further, the 13B40 is more likely to have successfully completed both the Basic Noncommissioned Officers Course (BNCOC) and the Advanced Noncommissioned Officers Course (ANCOC), while most 13B30s will have attended only BNCOC.

ANCOC training aside, the aptitude requirements for 13B30 appear adequate for learning to perform all of the listed 13B40 tasks. In fact, these tasks are all taught in Field Artillery ANCOC, which at least some 13B30s attend. All but two are procedural tasks that appear to be deferred to skill level 4 primarily because the equipment or information involved is located at the battery level and not because any special qualifications are needed. The remaining two tasks also are covered in ANCOC: Manage and Coordinate Supply and Resupply and Direct Tactical Movement. However, these two tasks are less procedural and they may depend on tactical and leadership abilities that some 13B30s may not possess. On the other hand, these abilities and any differences in knowledge or skill needed to achieve proficiency in these tasks could be addressed easily with additional selection standards and formal training for the AFAS Section Chief.

The remaining task, Submit Survey Reports and Operate PDS, is typically performed by an MLRS Crewman (13M10) or a Field Artillery Surveyor (82C10). Although some physical qualifications for 82C exceed those for 13B, those for 13M and 13B are identical suggesting no limit in performance capability relative to this task would be evident among 13Bs. Aptitude profiles for 13B, 13M, and 82C are all different, but this task, in the context of AFAS, consists of no more than operating digital electronic equipment. Since the M109 Section Chief currently accesses the Battery Computer System (BCS) for fire direction using procedures similar to the PDS, the aptitude qualifications for MOS 13B should be sufficient. In case of PDS failure, the Section Chief would have to lay the howitzer manually using fixed survey points. This skill now is taught in BNCOC but it is performed only at the battery level, usually by the Gunnery Sergeant. Nevertheless, a 13B30 would have the aptitudes needed to learn this task.

In summary, it appears that a 13B30 meets nearly all of the basic KSAP requirements for the position of AFAS Section Chief. The principal exceptions are in the skills acquired by attending ANCOC. In addition to radio communication and similar procedures taught in ANCOC, this is the primary source of a Field

Artillery soldier's training in tactical decisionmaking, a set of skills that will be needed by the AFAS Section Chief to lead his section's independent operations. Partly, these tactical skills include map reading and land navigation, skills that in principle must be mastered to successfully complete AIT (Advanced Individual Training) as well as BNCOC and ANCOC. However, these skills are not used frequently except at the battery level and considerable practice may be needed before a 13B30 Section Chief will achieve proficiency.

ANCOC would contribute to qualifying a 13B30 for the Section Chief position in three ways. First, not all 13B30s and 13B40s are selected to attend. Grade and time in service are considered, but performance ratings and leadership potential perhaps are the most significant variables. Selection for ANCOC implies the individual has these qualities. Second, the majority of the instruction in Field Artillery ANCOC is devoted to leadership, tactics and similar issues. Exposure to this instruction will strengthen these skills. And, third, the successful completion of ANCOC indicates not only that the course content has been mastered, but also that the instructors are confident the soldier is qualified for additional responsibility. Thus, although a 13B30 is likely to be generally qualified for the position of AFAS Section Chief, he will need the skills and knowledge taught in Field Artillery ANCOC and, more importantly, he will need the abilities that contribute to selection for, and graduation from, this training.

Specific skill training on equipment unique to AFAS also will be required, as described in the next step. Otherwise, a 13B30 can be expected to have the leadership skills, the procedural knowledge and the mature judgment needed to direct his AFAS section successfully. No new MOS appears warranted. 13B is a broad MOS that encompasses a wide range of weaponry; AFAS is not expected to differ so substantially from existing equipment to justify the creation of a new MOS for this purpose. For similar reasons, no special ASI designation for AFAS is appropriate. As to grade level, the 13B30 E-6 assigned as AFAS Section Chief will have considerably greater decisionmaking responsibility than one assigned as an M109 Section Chief. However, the size of his section will be reduced substantially. The project recommends the position of AFAS Section Chief be filled by a 13B30 E-6.

Step 8. Derive Manpower, Personnel and Training Implications Based on the KSAP Requirements

Purpose

The purpose of this step is to review the KSAP requirements for the new key position in order to determine any manpower, personnel, or training (MPT) implications that should be considered prior to fielding AFAS. Current MPT resources were evaluated and suggestions were made for adapting these to

accommodate the demands of the new key position. Also, an optional KPA analysis was undertaken to determine whether any of the tasks for the new key position are likely to pose special problems or make special demands on available MPT resources.

Activities

Project staff reviewed the composite list of KSAP requirements and information about the reference positions now performing similar tasks to determine what competencies would be required for the new key position. These requirements were then compared to manpower data collected during the project. Special attention was given to the NCO development programs because of their special relevance to the AFAS Section Chief position. Nearly all M109 Section Chiefs have attended BNCOC, but only a few presently attend ANCOC. BNCOC and ANCOC curricula were examined to determine whether any changes in those programs might be necessary to prepare 13B30s as AFAS Section Chiefs. BNCOC and ANCOC graduation rates for the last two years also were analyzed to establish potential manpower qualifications. Based on these analyses, project staff identified several manpower, personnel, and training concerns that may apply to the new key position.

As an optional step in the KPA procedure, it sometimes is desirable to survey knowledgeable combat developers and SMEs to rate the tasks that have been identified as key personnel duties to determine ones that are likely to be difficult to learn or to perform. For this research, 10 SMEs familiar with section and battery M109 operations were asked to rate each of the 58 MOS 13B tasks that would be the responsibility of the AFAS Section Chief for:

- task performance difficulty (TPD);
- frequency of performance (FP);
- task learning difficulty (TLD);
- time to train (TT); and
- decay rate (DR).

These are five of the six dimensions assessed during an Early Comparability Analysis (ECA), a methodology developed by the Soldier Support Center-National Capitol Region, to identify hardware-related tasks having MPT implications that should be considered during the development of a new weapon system. The SMEs also were asked to identify the five tasks from among the 58 AFAS Section Chief tasks they thought were most often performed improperly due to their difficulty.

Findings

A summary of the optional survey findings is presented in Table 5. As shown in the table, the two methods for establishing which AFAS Section Chief tasks might be most difficult to learn and perform yielded very similar results. The one task with the highest opinion score, representing the number of SMEs who chose that task as one of the five or so most difficult, also was the only one with a task rating that exceeded the standard of 90.0 for a "high driver" for tasks rated on five dimensions as it has been defined for an ECA. This one task was Use ECCM.

Table 5

AFAS Section Chief Task Ratings Distribution

Number of Tasks	Opinion Score	Mean Task Score
0	10	-
0	9	-
0	8	-
0	7	-
1	6	101.09
0	5	-
0	4	-
5	3	49.87
9	2	33.39
10	1	30.26
33	0	18.57
58		

Complete findings from the survey are shown in Table 6. Mean ratings on a scale of 1.00 (low) to 4.00 (high) are given for the five dimensions: TPD, FP, TLD, TT and DR. These ratings are multiplied together to give a combined "score" similar to the task score produced by an ECA. The final column indicates the number of SMEs from the group of 10 who considered that task among their 5 most difficult.

Table 6

Ratings of Individual AFAS Section Chief Tasks

	Task	TPD	FP	TLD	TT	DR	SCORE	OP
1.	Conduct reconnaissance operations	2.50	2.10	1.80	2.70	2.10	53.58	2
2.	Supervise recovery and prepare for movement	1.50	2.80	1.40	1.90	1.60	17.88	0
3.	Direct tactical movement	2.20	2.20	2.00	2.80	2.20	59.67	3
4.	Supervise occupation of position area	1.60	2.00	1.70	2.20	1.70	20.35	2
5.	Establish and operate radio communications	1.70	2.00	1.80	2.10	1.90	24.42	0
6.	Employ ECCM	3.00	1.30	2.70	3.20	3.00	101.09	6
7.	Employ SIGSEC techniques during radio use	2.20	2.00	2.60	2.70	2.60	80.31	3
8.	Direct defense against ground attack (stationary)	1.90	2.00	2.20	2.40	2.20	44.14	2
9.	Direct defense against ground attack (moving)	2.20	2.30	2.00	2.30	2.10	48.88	1
10.	Direct defense against air attack (stationary)	2.10	2.10	2.00	2.40	2.30	48.69	1
11.	Direct defense against air attack (moving)	2.20	2.00	2.00	2.30	2.10	42.50	1
12.	Prepare section for combat operations in NBC environment	2.10	2.70	2.30	2.50	1.90	61.94	0
13.	Give a situation report	1.70	2.00	1.90	1.80	1.90	22.09	0
14.	Give a shell report	1.70	2.00	1.60	1.90	1.90	19.64	0
15.	Give an NBC report	1.80	2.30	2.00	2.20	2.20	40.08	1

Table 6 (continued)

Ratings of Individual AFAS Section Chief Tasks

	Task	TPD	FP	TLD	TT	DR	SCORE	OP
16.	Submit survey reports and combat information	2.20	2.10	2.30	2.60	2.10	58.02	3
17.	Direct emplacement and lay of cannon	1.20	3.10	1.40	2.10	2.10	22.97	1
18.	Direct emplacement and selection of reference points	1.20	3.40	1.30	2.10	1.80	20.05	2
19.	Determine and report site to crest range	1.00	3.50	1.20	1.30	1.80	9.83	0
20.	Direct boresighting of the howitzer	1.20	3.50	1.20	1.50	1.90	14.36	0
21.	Perform prefire checks	1.10	3.50	1.20	1.20	1.90	10.53	0
22.	Ensure ammunition prepared for conduct of fire missions	1.20	3.40	1.20	1.50	1.60	11.75	0
23.	Direct laying on a planned priority target	1.40	2.90	1.50	1.40	1.60	13.64	0
24.	Supervise (section) position improvements	1.40	3.20	1.20	1.50	1.70	13.71	1
25.	Process fire commands	1.90	2.90	2.20	2.80	2.30	78.07	0
26.	Supervise preparation of ammunition for firing	1.00	3.40	1.30	1.40	1.80	11.14	0
27.	Direct loading of howitzer	1.10	3.30	1.10	1.10	1.60	7.03	0
28.	Supervise laying for deflection and quadrant	1.10	3.50	1.10	1.10	1.60	7.45	0
29.	Direct section in firing of howitzer	1.20	3.40	1.20	1.50	1.70	12.48	0

Table 6 (continued)

Ratings of Individual AFAS Section Chief Tasks

	Task	TPD	FP	TLD	TT	DR	SCORE	OP
30.	Supervise direct fire procedures	1.20	3.00	1.50	1.80	1.60	15.55	2
31.	Supervise unloading of howitzer	1.30	2.20	1.10	1.10	1.70	5.88	0
32.	Manage and submit records of fire and reports	1.50	3.10	1.60	1.50	1.90	21.20	3
33.	Supervise storage and transport of ammunition	1.10	3.20	1.20	1.40	1.40	8.28	0
34.	Supervise draw and turn-in of ammunition	1.30	2.50	1.90	1.50	1.70	15.75	0
35.	Maintain and report ammunition information	1.30	2.80	1.40	1.40	1.30	9.27	0
36.	Supervise repair and replacement of equipment	1.60	3.50	2.00	2.00	1.60	35.84	0
37.	Manage and coordinate supply and resupply	1.70	2.90	1.80	2.00	1.70	30.17	3
38.	Supervise preparation of vehicle for combat	1.30	3.20	1.40	1.80	1.80	18.87	0
39.	Assure section readiness	1.60	3.40	1.50	2.30	1.80	33.78	0
40.	Manage and conduct crew training	1.30	3.30	1.70	2.10	2.00	30.63	2
41.	Direct misfire procedures	1.20	2.90	1.50	1.50	1.60	12.53	0
42.	Determine site to crest and range to crest	1.10	3.50	1.30	1.10	1.50	8.26	0

Table 6 (continued)

Ratings of Individual AFAS Section Chief Tasks

	Task	TPD	FP	TLD	TT	DR	SCORE	OP
43.	Perform gunner's quadrant micrometer test	1.10	3.40	1.40	1.20	1.50	9.42	0
44.	Perform gunner's quadrant end-for-end test	1.10	3.40	1.40	1.30	1.60	10.89	0
45.	Determine that the howitzer is safe to fire	1.20	3.50	1.40	1.60	1.30	12.23	1
46.	Compute data for a sweep and zone fire mission	1.70	2.60	1.40	1.50	1.50	13.92	2
47.	Set and lay for quadrant using the gunner's quadrant	1.10	3.30	1.20	1.20	1.20	6.27	0
48.	Measure quadrant with gunner's quadrant	1.10	3.20	1.40	1.30	1.30	8.33	0
49.	Issue fire order for direct fire mission	1.70	3.00	1.60	1.80	1.70	24.97	1
50.	Maintain DA Form 2408-4 (Weapon Record Data)	1.40	3.30	1.80	1.80	1.60	23.95	1
51.	Update and maintain technical publications	1.80	2.00	2.10	2.00	2.60	39.31	2
52.	Prepare a load plan (fill out DA Form 2491-R)	1.60	2.40	1.90	1.90	2.10	29.11	0
53.	Determine howitzer muzzle velocity using M90 chronograph	1.50	2.40	2.00	1.90	1.80	24.62	1
54.	Process fire missions using gun display unit	1.30	3.20	1.40	1.40	1.30	10.60	0

Table 6 (continued)

Ratings of Individual AFAS Section Chief Tasks

	Task	TPD	FP	TLD	TT	DR	SCORE	OP
55.	Perform land navigation and map reading	2.00	3.00	2.10	2.50	2.00	63.00	2
56.	Verify PMCS on M109 howitzer	1.30	3.20	1.60	1.90	1.50	18.97	0
57.	Adjust the equilibrators on the M109	1.80	2.00	2.40	2.10	2.30	41.73	0
58.	Perform a zero pressure check on the M109 hydraulic system	1.10	3.30	1.20	1.20	1.30	6.80	0
59.	Submit survey reports and operate PDS	not rated by 13B SMEs						

This optional survey was very helpful in confirming the suitability of a 13B30 for the position of AFAS Section Chief. Aside from the ECCM task, the 58 MOS 13B tasks all were rated in a way that suggests they represent no particular difficulty to incumbent M109 13B30s and 13B40s. However, the KPA revealed a number of manpower, personnel and training implications that should be considered in planning the AFAS Section Chief position.

Manpower. The KSAP composite for the AFAS Section Chief indicated that 13B30 is the most suitable candidate for this new key position. Assuming that the overall number of soldiers in MOS 13B remains constant despite the smaller AFAS crew, the primary manpower issue is whether a sufficient number of E-6s in the 13B MOS will be available to fill the projected number of AFAS Section Chief positions. If twice as many AFAS sections will be fielded as M109 sections, more personnel will be needed at skill level 3 than presently are required for the M109s they will replace. Furthermore, the proportion of 13B30s needed relative to lower grades of 13Bs will increase because of the smaller size of AFAS sections compared with M109 sections. This could result in a significant shift in the distribution of 13Bs across grades and some appearance of "grade creep" at the 13B30 level.

The creation of more 13B30s may result in an additional manpower problem in terms of further career progression for these

soldiers. A larger number of skill level 3 personnel means a larger pool will be available for promotion to skill level 4. However, the 13B MOS currently does not have sufficient senior NCO positions to sustain more personnel at skill level 4. New promotion opportunities might have to be established to permit these additional 13B30s to advance in their careers. The consequences of a "bottleneck" at the 13B30 level ultimately might discourage more capable individuals from entering this MOS and, in turn, diminish the supply of soldiers qualified to be AFAS Section Chiefs.

Another potential manpower issue noted by project staff is that in at least two of the branches examined during this KPA and related MANPRINT studies for AFAS, the Ordnance and Field Artillery branches, electrical and electronic tasks frequently are becoming the responsibility of personnel holding MOSs that only peripherally include electrical and electronic equipment. Yet these tasks often appear as "high drivers" or otherwise are identified among the tasks that are the most difficult to learn or the most difficult to perform by incumbents of these MOSs. One task in this research, Employ ECCM, was identified as the most difficult of the tasks to be performed by the AFAS Section Chief. Nothing inherent in performing electrical or electronic tasks seems to account for this perceived difficulty.

It is quite possible that many of the Army recruits available for MOSs that now use electrical or electronic equipment neither understand the equipment nor are comfortable operating or maintaining it. Soldiers holding these MOSs appear wary about tampering with, using, or trying to fix electronic equipment even though they may have had the necessary technical training. This discomfort was encountered so often over the course of the AFAS MANPRINT project that it appears to be a core problem not only for the Ordnance and Field Artillery branches, but possibly for the Army as a whole. Although the problem may resolve itself as electronics equipment becomes more commonplace in these MOSs, some consideration should be given to introducing electronics training as early as possible in a soldier's career so he can become more familiar and comfortable with this category of equipment.

Personnel. As the findings for Step 7 indicate, the aptitudes and physical abilities of a 13B30 appear adequate for the position of AFAS Section Chief. However, certain knowledges and skills required for this position will have to be learned. The primary personnel question, then, is whether 13B30s have the capabilities needed to achieve proficiency in these skills. There are two principal areas of concern: first, whether a 13B30 being considered for the position of AFAS Section Chief has the mature judgment needed to successfully manage subordinates under stressful conditions and, second, whether he is able to make the appropriate tactical combat decisions during the conduct of independent section operations.

One indicator of the proportion of 13B30s who have these abilities is the pass rate for the MOS 13B soldiers who attend Field Artillery BNCOC and ANCOC. As shown in Table 7, roughly 95 percent of NCOs entering BNCOC or ANCOC can be expected to successfully complete the course according to data supplied by the Proponency Office, Fort Sill.

Table 7

BNCOC and ANCOC Course Accessions

13B BNCOC			
FY86:			
Entered:	239	Non-Graduates:	7 administrative
Graduated:	224		6 academic failure
	(93.7%)		2 punitive
13B BNCOC			
FY87:			
Entered:	214	Non-Graduates:	1 medical release
Graduated:	206		2 academic failure
	(96.2%)		5 punitive
13B ANCOC			
FY86:			
Entered:	269	No non-graduate data available	
Graduated:	266		
	(98.8%)		
FY87:			
Entered:	191	No non-graduate data available	
Graduated:	179		
	(93.7%)		

In light of these percentages, no additional criteria beyond the ability to at least complete BNCOC appear to be necessary for selecting AFAS Section Chief candidates. Also, although supervision and combat decisionmaking are not qualifying factors for a 13B30, career progression to E-6 is based on evaluation reports that stress a soldier's leadership and decisionmaking potential. Promotion to E-6 often includes attending BNCOC, and the BNCOC curriculum emphasizes battery level duties most often performed by 13B40s as well as leadership skills. Furthermore, the large amount of on-the-job training (OJT) conducted within the Field Artillery branch helps prepare 13B30s to assume skill level 4 responsibilities long before they are promoted.

Referring back to the manpower issues just raised, however, the pool of 13Bs eligible for promotion to E-6 may not be large enough to sustain this much selectivity in determining who should become an AFAS Section Chief. If more E-6s with SPH experience will be required to fill these positions, and if the successful completion of BNCOC also is used as a criterion, many more soldiers will have to attend this training. Dipping farther into the pool of eligibles may, in turn, lead to reduced BNCOC selection standards. As a result, the proportion of graduates may go down or the level of attainment now required to successfully complete the course may have to be reduced. Either choice will strain efforts to assure an adequate flow of qualified personnel who can be assigned as AFAS Section Chiefs.

Training. If 13B30 is established as the appropriate MOS and skill level for the position of AFAS Section Chief, two skill development problems will be encountered. First, considerable transition training will be needed to prepare current M109 Section Chiefs for the AFAS. A program of instruction (POI) must be created and implemented before the AFAS is fielded to assure the availability of essentially competent Section Chiefs. This POI should address the new equipment features of AFAS including its position determining system, radio communications equipment, automatic fire control system, and ammunition loading and transloading equipment.

It also may be necessary to insure that potential AFAS Section Chiefs receive adequate leadership and decisionmaking training. In the long term, the experiential OJT already counted on heavily in the Field Artillery branch for career progression would apply to qualifying candidates for the position of the AFAS Section Chief. Once AFAS has been fielded for several years, personnel would progress into the position of Section Chief as they do now with respect to the M109. However, tactical decisionmaking and other, technical skills may be so critical that formal training is required. BNCOC would be the logical opportunity to provide this training if its content were revised to include the AFAS Section Chief duties now performed by 13B40s and taught in ANCOC, particularly the operation of electronic equipment, battlefield tactics, map reading and land navigation, and some leadership and management.

Much of the planning needed to implement new training programs for AFAS already has been created for the interim HIP self-propelled howitzer (M109A3E2/3). This weapon will include automatic fire control, position determining and radio communications systems similar to those proposed for AFAS. With these features, HIP is capable of operating independently of a battery position and, therefore, newly assigned HIP Section Chiefs will require much of the same training that would be required for AFAS. Personnel experienced in HIP operations should have almost no difficulty transitioning to AFAS except for some equipment familiarization.

Requirements for two training devices have been established to facilitate preparing operating personnel for HIP. One is a self-contained classroom device, the IFCST (Institutional Fire Control System Trainer). This device will provide realistic instruction in both normal and malfunction operation of the AFCS (Automatic Fire Control System), the PDS, and associated communications equipment. With this device, students will be able to practice almost all tasks not now performed on the M109 except for vehicle movement and repositioning. The IFCST will be employed during BNCOC to provide initial entry and skill proficiency training for 13B students likely to be assigned as HIP Section Chiefs.

The second training device will be the incorporation of embedded training (ET) capabilities into the AFCS installed on HIP for both entry level and sustainment training covering the new equipment. These capabilities will facilitate both transition training when the HIP is first fielded and then the unit-level sustainment training needed to maintain proficiency. The use of ET is expected to provide HIP Section Chiefs and crews with the controlled practice and realistic experience they will need to achieve competency in processing fire commands, recognizing malfunctions in the AFCS and associated systems, and transmitting messages back to the battery.

One additional training device capability should be considered for AFAS collective crew training. Because of the importance of vehicle movement to the way both AFAS and HIP will operate, it would be desirable to permit the conduct of realistic field exercises without the cost in time, fuel or wear on the vehicle that would result from traveling authentic distances. This capability, perhaps achieved by augmenting the ET device planned for the HIP, would simulate the PDS readings for lengthy movements after the vehicle had traveled only a short distance.

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List of Acronyms

AFAS	Advanced Field Artillery System
AFCS	Automatic Fire Control System
AIT	Advanced Individual Training
ANCOC	Advanced Noncommissioned Officers Course
AR	Army Regulation
ARI	Army Research Institute for the Behavioral and Social Sciences
ARTEP	Army Training and Evaluation Program
ARV	Armored Resupply Vehicle
ASI	Additional Skill Identifier
ASVAB	Armed Services Vocational Aptitude Battery
BC	Battery Commander
BCS	Battery Computer System
BNCOC	Basic Noncommissioned Officers Course
BSC	Battalion Survey Chief
CFB	Chief of Firing Battery
DA	Department of the Army
DR	Decay Rate
ECA	Early Comparability Analysis
ECCM	Electronic Counter-Counter Measures
ET	Embedded Training
FA	Field Artillery
FAS	Field Artillery Surveyor
FATRFA	Turret Repairer
FDC	Fire Direction Center
FDNCO	*Fire Direction NCO*
FDO	Fire Direction Officer
FFE	Fire for Effect
FM	Field Manual
FP	Frequency of Performance
FSMAA	Fire Support Mission Area Analysis
GS	Gunnery Sergeant
HARDMAN	Hardware versus Manpower
HELP	Howitzer Extended Life Program
HFEA	Human Factors Engineering Analysis
HIP	Howitzer Improvement Program
IFCST	Institutional Fire Control System Trainer
KPA	Key Position Analysis
KSAP	Knowledge, Skill, Aptitude, Physical
LHX	Light Helicopter Experimental
MANPRINT	Manpower and Personnel Integration
MENS	Mission Element Needs Statement
MEPSCAT	Military Enlistment Physical Standards Capacity Test
MH	Moderately Heavy
MLRS	Multiple Launch Rocket System
MOS	Military Occupational Specialty
MP	Mission Profile
MPT	Manpower, Personnel and Training
MSG	Maintenance Sergeant
NBC	Nuclear, Biological and Chemical
NCO	Noncommissioned Officer

OF	Operations of Food
OMS	Operational Mode Summary
O&O	Operational and Organizational (Plan)
OJT	On-the-Job Training
PDS	Position Determining System
PLL	Prescribed Load List
PMCS	Preventive Maintenance Checks and Services
POI	Program of Instruction
POL	Petroleum, Oils and Lubricants
PULHES	Army Physical Profile Serial
SC	Section Chief
SIGSEC	Signal Security
SM	Soldier's Manual
SME	Subject Matter Expert
SOP	Standard Operating Procedures
SPH	Self-Propelled Howitzer
SQT	Skill Qualification Test
TAD	Target Audience Description
TLD	Task Learning Difficulty
TOE	Table of Organization and Equipment
TPD	Task Performance Difficulty
TSM	TRADOC System Manager
TT	Time to Train
USAFAS	U.S. Army Field Artillery School
VH	Very Heavy
VT	Variable Time
XO	Executive Officer
1SG	First Sergeant

Appendix A

AFAS Crew Size Substudy

Summary

During the course of a larger study concerned with the changing role of the Section Chief from the M109 self-propelled howitzer to the Advanced Field Artillery System (AFAS), the opportunity and need emerged to examine crew size issues. The purpose of this substudy was to examine the nominal crew size for the AFAS howitzer, as specified by the Use Study and the Operational and Organizational (O&O) Plan, to determine possible impacts on AFAS operations and survivability under the proposed 72-hour battle concept. The substudy includes the identification of crew tasks that may be affected as well as discussions of crew selection qualifications, the implications of the reduction in crew size for cross-training, and the grade levels appropriate for AFAS crew personnel.

Data for this substudy were obtained from surveys of subject matter experts (SMEs) and a panel of AFAS combat developers at USAFAS, Fort Sill, during the conduct of the role change research, and using information developed during that research. The substudy steps were to:

a. Develop a comprehensive list of crew operations derived from ARTEP 6-100 and several composite mission scenarios that would characterize the activities of, and demands on, an AFAS crew during combat;

b. Survey a group of 5 USAFAS SMEs to identify those howitzer crew operations from the list that require four or more individuals to perform;

c. Determine, for those operations requiring four or more personnel to perform, the number needed based on descriptions contained in FM 6-50, appropriate Technical Manuals, and the SMEs;

d. Examine groups of crew operations having high personnel demands with the help of a panel of AFAS combat developers to determine the crew's ability to continue its mission under certain conditions and types of degraded modes; and

e. Consider the implications of a reduced crew size on the scope of cross-training for an AFAS crew and on the grade levels appropriate to personnel within an AFAS crew.

Combat developers and SMEs identified probable tactical and combat stresses on the AFAS howitzer crew and its individual members. The tactical stresses included the conduct of reconnaissance, vehicle defense, preparation and loading of ammunition, unloading the cannon, and the draw and turn-in of

ammunition. Combat stresses with respect to the individual crew members included equipment malfunctions, ammunition handling, and time for eating, personal hygiene and sleep.

The 3-man howitzer crew proposed by the AFAS Use Study and the O&O was determined feasible by the project staff, if likely crew fatigue during loading could be relieved through robotic loader-assist equipment and if transfer equipment or additional support personnel will be available from the resupply vehicle when receiving or turning in ammunition. Robotic loader-assist equipment also may allow the AFAS crew to maintain a higher burst rate and eliminate the need for an additional cannoneer, now needed to prevent the fatigue that otherwise could severely impair the section's ability to continue firing at the high rate specified for the system. If a 3-man crew is adopted for AFAS, the position configuration and grade level suggested for the crew is Section Chief, E-6; Driver-Assistant Gunner, E-4; and Cannoneer, E-3.

The project staff also recommended that cross training be made an integral part of both AFAS transition training and unit training in order to maintain the crew's capability to continue operating under expected types of degraded mode. The final substudy recommendation was that the AFAS Section Chief must be given the authority to act in place of an officer in certain situations. Responsibilities should be delegated to an E-6 under emergency circumstances, such as special weapons courier duties, when an officer might not be accessible because of dispersed battlefield conditions.

Introduction

The Advanced Field Artillery System (AFAS) has been proposed as the next generation self-propelled cannon field artillery weapon. It is intended to succeed the M109A2/A3 self-propelled 155mm howitzer now widely deployed to provide tactical indirect fire support. The concept exploration phase of the weapon system procurement cycle for AFAS was initiated in 1985. Subsequent developments have led to a decision to achieve AFAS capabilities in a series of incremental improvements to the present M109 through the Howitzer Improvement Program (HIP), rather than through a new weapon start. The goals in terms of weapon system characteristics and operations, however, remain the same.

The design concept for AFAS is directed at carrying out the dispersed battlefield concept outlined in Army 21. Within this concept, the Field Artillery battery and section of the future will operate on much larger fronts than they do now. To accomplish their mission and reduce the consequences of enemy counterfire, individual AFAS howitzers will conduct operations away from a conventional battery position that typically is occupied by four to six howitzer sections. Instead, each howitzer will operate independently at some distance from either battery headquarters or other howitzers. Other operational

concepts for AFAS include frequent movement from one position to another, a capacity for a substantial higher rate of fire, and continuous deployment for periods as long as 72 hours.

To facilitate this new operational concept, the AFAS will be fielded with state-of-the-art electronics equipment including a computerized fire control system, a position determination system (PDS), and secure digital and voice radio communications systems.

The support concept for AFAS is not yet well established. However, it is likely that the AFAS will be supported by an armored resupply vehicle (ARV), similar in function to the one now used to support M109 sections. The ARV will provide the howitzer with fuel, ammunition, food, replacement personnel, repair parts and some maintenance support. Since the howitzers will be dispersed and operate apart from one another, the supporting ARV likely will shuttle between the howitzer and a separate battery headquarters or resupply position.

The current M109 section has between eight and ten personnel, led by an E-6 (13B30) Section Chief. The Section Chief is assisted by two E-5 (13B20) Assistant Section Chiefs, one serving as gunner for the howitzer and the other as Armored Resupply Vehicle (M548) team chief. The remainder of the M109 crew is composed of Skill Level 1 cannoneers and ammunition handlers, usually divided evenly between the M109 and M548. Typically, there will be five personnel on the howitzer and four on the resupply vehicle. This large a crew is required primarily to transload, by hand, large amounts of ammunition required during combat operations and to provide the personnel needed to continue combat operations over an extended period of time. If equipment improvements could eliminate the section's need for ammunition handlers, and if some alternative solution to the crew rotation problem could be identified, it might be possible to operate the howitzer with fewer crew members.

The minimum crew size needed operate the new weapon system is a significant concern to combat developers. One of the goals for the AFAS is a reduction in crew size, hopefully to only three members for the howitzer itself. During the course of a larger study concerned with the changing role of the Section Chief from the M109 to AFAS, the opportunity emerged to also examine crew size issues with little additional effort. This substudy was therefore undertaken to examine the impact of a significantly reduced crew size on the likely performance of an AFAS howitzer.

Purpose

The purpose of this substudy was to examine the nominal crew size for the AFAS howitzer, as specified by the Use Study and the Operational and Organizational (O&O) Plan, to determine possible impacts on section operations and survivability under the proposed 72-hour battle concept. The substudy included the identification of crew tasks that may be affected, and

discussions of crew selection qualifications, the implications of a reduction in crew size for cross-training, and the grade levels appropriate for crew personnel.

Methodology

This substudy was carried out as a part of an analysis of changes in the role of the Section Chief between the M109 and the AFAS. Data for this substudy were obtained from a survey of subject matter experts (SMEs) at USAFAS, Fort Sill, during the conduct of role change research and using information developed during that research. Additional data were obtained from a panel of five combat developers working on the AFAS program. The specific steps of the substudy were to:

a. Develop a comprehensive list of crew operations derived from ARTEP 6-100 and several composite mission scenarios that would characterize the activities of, and demands on, an AFAS crew during combat;

b. Survey a group of 5 USAFAS SMEs to identify those howitzer crew operations from the list that require four or more individuals to perform;

c. Determine, for those operations requiring four or more personnel to perform, the number needed based on descriptions contained in FM 6-50, appropriate Technical Manuals, and the SMEs;

d. Examine groups of crew operations having high personnel demands with the help of a panel of AFAS combat developers to determine the crew's ability to continue its mission under certain conditions and types of degraded modes; and

e. Consider the implications of a reduced crew size on the scope of cross-training for an AFAS crew and on the grade levels appropriate to personnel within an AFAS crew.

Results

The Section Chief role change research provided a tentative list of 49 crew operations, or collective tasks, that an AFAS crew would have to perform during the course of a 72-hour mission. Operator maintenance and special weapons tasks were excluded both from the main study and from this substudy. The list was then reviewed by a panel of cannon artillery combat developers at USAFAS who suggested various deletions and changes, reducing the list to 37 crew operations. A group of 5 USAFAS SMEs then was asked to review the list and indicate, for each operation, the number of crew members required to perform it. Agreement among them was by consensus. The only dissension was

one respondent who suggested that "Conduct reconnaissance" should be considered a crew operation requiring four personnel rather than three.

Survey Data

The results from the group of USAFAS SMEs are shown in Table A-1. The number at the right of each crew operation is the number of crew the SMEs judged necessary to perform it. Among the 37 crew operations considered, the performance of 16 require only one crew member, four require only two crew members, seven require three crew members, and 10 require four crew members. None require more than four personnel.

Table A-1

Number of Personnel Required to Perform Each of 37 AFAS Operations

	Operator	Crew Required
1.	Conduct reconnaissance operations	4
2.	Recover and prepare for movement	3
3.	Perform tactical road march	3
4.	Occupy position area	3
5.	Establish and operate radio communications	1
6.	Employ ECCM	1
7.	Employ SIGSEC techniques	1
8.	Defend against ground attack (stationary)	4
9.	Defend against ground attack (moving)	4
10.	Defend against air attack (stationary)	4
11.	Defend against air attack (moving)	4
12.	Prepare for combat operations in NBC environment	3
13.	Give a situation report	1
14.	Give a shell report	1
15.	Give an NBC report	1
16.	Report survey control points and combat information	1
17.	Draw and turn in ammunition	4
18.	Transport ammunition	4
19.	Maintain and report ammunition information	1
20.	Manage maintenance records	1
21.	Repair and replace equipment	3
22.	Maintain prescribed load list	1
23.	Establish and extend survey control	2
24.	Emplace and lay cannon	3
25.	Determine and report site to crest range	1
26.	Boresight the howitzer	2
27.	Perform prefire checks	1
28.	Prepare ammunition for conduct of fire missions	4
29.	Lay on a planned priority target	2

Table A-1 (continued)

Number of Personnel Required to Perform Each of 37 AFAS Operations

Operator	Crew Required
30. Process fire commands	1
31. Prepare ammunition for firing	4
32. Load howitzer	1
33. Lay for deflection and quadrant	2
34. Fire the howitzer	1
35. Fire a direct fire mission	3
36. Unload the howitzer	4
37. Manage and submit records of fire and reports	1

Combat Developer Comments

After the panel determined the number of personnel needed to perform each crew operation, a group of five combat developers participating in the AFAS program was asked to consider and comment on each crew operation identified as requiring four personnel. Their comments are summarized in the following paragraphs, organized according to groups of related tasks:

1. Reconnaissance (Operation 1). One combat developer thought this task would require at least four personnel to perform (sweep the position and establish ground security before it can be occupied by an M109 battery). This operation is not now directed by the individual M109 Section Chiefs. Instead, it is a battery-level responsibility carried out by the Gunnery Sergeant with the assistance of one crew member from each howitzer section. Also, the AFAS operating concept will change the character of position occupation significantly. The period of time the AFAS vehicle will remain in one position is much shorter. A visual check, in combination with maximum use of battlefield intelligence, should be sufficient for the AFAS howitzer to occupy a position. In addition, risks to the crew might be too great (i.e., NBC threat) for a crew member to dismount from the vehicle. The only reason a crew member might have to dismount during AFAS positioning would be to confirm that the ground is firm enough to support the vehicle, but this is information that should be available as battlefield intelligence. If it was necessary for the AFAS crew to secure a position perimeter against ground attack, at least four personnel would be required, a minimum of three to define an area and one to operate the radio on the

vehicle. However, it is not likely that an AFAS would occupy a fixed position for a long enough period during a 72-hour battle to warrant establishing a perimeter.

2. Ground Defense (Operations 8, 9, 10 and 11). Although the AFAS howitzer will have crew-served weapons such as an M-2 .50-cal machine gun to defend itself, the level of security now provided by an M109 battery perimeter and the battery's ability to mass small arms fire in response to an attack no longer will be available to the individual AFAS howitzer. To defend the AFAS vehicle against ground attack, one man would be needed to operate the .50-cal machine gun from an exposed position, one man would remain in the driver's compartment to facilitate rapid displacement, and one man would report the contact and maintain radio communications. Thus, one of these duties would have to be performed by the AFAS Section Chief in addition to his supervisory responsibilities. Were the AFAS crew to dismount and fight back against a ground attack, there would be a substantial increase in the risks to crew safety and mission accomplishment. Perhaps the best response would be for the AFAS to avoid conflict as much as possible by using its mobility for defense, much like the MLRS or a Cavalry Scout section.

3. Prepare Ammunition and Load Howitzer (Operations 28 and 31). Any of the ammunition handling operations that occur inside the vehicle could be accomplished, if necessary, by one person. A potential problem exists, however, in meeting the Use Study's desired very high burst rate. With a 4-person crew, no more than two crew members could be available to perform all fusing, loading and associated operations. One remaining crew member should be operating the radio and fire control equipment. Another crew member should be available to drive the vehicle for a hasty displacement on completion of firing. This same crew member could manually position the cannon if required for operations in a degraded mode. A 3-man crew would be feasible if the radio and other electronics could be operated from the driver's position by the Section Chief. On the other hand, even two ammunition handlers might quickly fatigue under "surge" conditions, projected by the Use Study as up to 911 rounds per day, and even under "committed" firing conditions of 473 rounds per day. Until an automatic loader or at least some loader-assist device is incorporated, as well as an automatic fuse setting capability, a crew of three would be unable to maintain the rate of fire envisioned for AFAS.

4. Draw and Turn In Ammunition (Operations 17 and 18). Considerable manpower currently is required to draw or turn in ammunition. At present, the usual practice is

for two personnel to offload ammunition from the M548 Cargo Carrier and hand it to two other personnel for ground storage. Then, as it is needed, one or two personnel transfer the ammunition from ground storage to another individual who replenishes storage racks inside the howitzer. The M109 racks have a capacity of only 22 rounds (34 rounds total on board including 12 stored in brackets on the floor of the crew compartment). Consequently, transfer operations to replenish the on-board supply must occur frequently during periods of high rates of fire. Ammunition transfer operations for AFAS are expected to be quite different for several reasons. First, because of the planned mobility of the system, even temporary ground storage of ammunition will be unlikely. Second, the design concept for AFAS and its supporting ARV calls for equipment that will permit the direct, automated transfer of ammunition using replaceable racks. Until that equipment is available, ammunition could be transferred from the ARV to the howitzer through the combined efforts of the crews of the two vehicles. With this arrangement, however, fatigue may be a problem for a 3-man AFAS crew and a similarly smaller ARV crew because the task will be required frequently, it will have to be performed quickly, and the howitzer crew then will have to continue the mission after taking on ammunition.

5. Unload the Howitzer (extraction of a projectile) (Operation 32). Performance of this operation on the M109 requires at least three personnel according to the Technical Manual, plus both the Section Chief and an officer in supervisory roles. One crewman must be in the howitzer cab to catch the projectile as it is freed from the breech. At least two other personnel are required to operate the bell rammer in order to free the stuck round. Because an officer might not be accessible under the AFAS concept, the Section Chief would have to become actively involved in the extraction operation as well as supervise it, which could have significant safety implications. Alternatively, the procedure might be considered a maintenance function to be performed by a maintenance "contact" team instead of by the crew, but then the howitzer may have to be out of action for an unreasonable amount of time.

Summary of Results

The group of USAFAS SMEs who were asked to specify the number of personnel required to perform each of 37 crew operations likely to be required during a 72-hour AFAS mission identified 10 as tasks dependent on four or more crew members. When these 10 crew operations were reviewed by a panel of AFAS

combat developers, however, it was their opinion that the need for more than three crew members was not supported in that reconnaissance and defense operations were much less likely to occur, in that the reduced crew size presumed equipment to assist in ammunition loading and transfer operations, and in that unloading a stuck round from the howitzer could be accomplished differently than now.

Discussion

Although the position of the AFAS combat developer panel was that the section could be operated by a crew of only three members, several related issues should receive further consideration. These include the cumulative effects of stress and fatigue, and the implications of adopting a 3-member crew on selection standards, cross-training requirements, and authorized grade levels for AFAS crew personnel.

Stress and Fatigue

The crew operations that might depend on four or more personnel are primarily those that will result from the large amount of ammunition the howitzer may expend. However, these are not the only sources of stress and fatigue likely to be encountered as the consequence of a substantial reduction in crew size. Others will result from the need to maintain full combat capability over a 72-hour period. These include:

1. Equipment Malfunction. The weapon system itself will be under considerable stress during battlefield conditions. Because of the frequent movement anticipated to increase survivability and to rendezvous frequently with an ARV for resupply, the AFAS vehicle is expected to travel some 24 kilometers per day. This represents a considerable increase over the distance usually covered by an M109. Also, a considerable higher rate of fire is expected for AFAS compared with the M109. Either of these requirements is likely to lead to rates of equipment malfunction that will have to be accommodated. And, because the individual AFAS howitzers will be widely dispersed, only limited assistance will be available from other sections or from battery and battalion resources. Dependence on the crew for diagnosing malfunctions and performing the necessary field repairs or, as an alternative, performing operations in a partly or wholly manual mode, will almost certainly result in additional crew stress and fatigue as well as the need for new knowledge and skill.

2. Ammunition Handling. The increased amount of ammunition to be expended by the AFAS section necessarily will increase the frequency of resupply

operations. Currently, it is assumed that there will continue to be a one-to-one ratio of ARVs to howitzers. Combat developers anticipate that an AFAS howitzer will have to replenish its ammunition supply from an ARV as many as six or more times per day. If either the automated equipment or the additional manpower needed to actually transload the ammunition onto the howitzer is available on the ARV, the size of the AFAS crew will not be a factor. Similarly, automated fuse setting and primer loading equipment is planned for AFAS, at least as long as conventional propellants continue to be used. Nevertheless, the need to lift several 95-pound projectiles and position them on the loader-rammer assist tray at intervals only a few seconds apart places heavy demands on the one individual who would be available to perform this task.

3. Casualties. The loss of just one of its three crew members, for any reason, will have a significant impact on the howitzer's ability to continue its mission. Attempts to sustain operations with only two personnel for even a few hours could seriously erode the howitzer's combat capability. It is conceivable that the AFAS howitzer could be operated in combat by only one individual. However, a crew of at least two will be required to even approach a "committed" level of fire support temporarily until the absent crew member could be replaced on the next resupply run.

4. Rest Time. The AFAS howitzer must maintain a 24-hour-a-day combat capability. Crew personnel, however, require time for eating, sleeping, and performing personal hygiene. Four hours per soldier per day is a realistic goal for a 72-hour conflict scenario. However, it would be necessary for crew members to rotate duties, at least during non-firing time, to provide even minimum personal time for every crew member and still maintain radio communications and a minimal ground defense. Rotation of crews with the ARV may be possible, but the ARV crew also is likely to be on the move continuously.

5. Night Operations. Operational planning for AFAS includes extensive operations during darkness. Although these plans focus on the need for around-the-clock indirect fire support, tactical considerations also will require frequent movement of the howitzer for more advantageous firing positions, for resupply operations and, more importantly, as a defense against counterfire. Nighttime movement in unfamiliar terrain, however, may require assigning one crew member to perform ground reconnaissance particularly for position selection. Night operations therefore could add considerable stress and preclude rest opportunities for the AFAS crew.

AFAS Crew Composition

Reducing the size of the howitzer crew to only three members has significant implications in three areas:

1. Personnel. The individual AFAS crew members each will have more responsibility with less backup and task supervision than members of an M109 crew. Also, considerable stamina and resistance to stress will be required to meet the demands of a 72-hour battle scenario and high rates of fire and movement. Maintaining an adequate level of physical readiness may become an important issue to insure the howitzer's effectiveness in combat.

2. Cross-Training. The work of the AFAS crew necessarily will have to be distributed among three people rather than five or more. The result is that the Section Chief will have to function both as a doer and supervisor for much of the work performed. Also, each AFAS crew member will have to be reasonably proficient in the duties of other crew positions, including the Section Chief position, to permit substitution in response to fatigue, rest periods or casualties. Cross-training, then, must be made an integral part of the AFAS training concept to insure the crew is combat ready.

3. Grade Levels. The current M109 section is authorized up to 10 personnel who operate two vehicles in the following assignments:

Primary operators on the M109 Howitzer:

1 E-6 Section Chief
1 E-5 Gunner
1 E-4 Assistant Gunner
1 E-4 Cannoneer-Assembler
1 E-4 Driver

Primary operators on the M548 Cargo Carrier:

1 E-4 Driver
4 E-3 Cannoneers-Ammunition Handlers

As presently planned, an AFAS section will include the howitzer with a 3- or 4-man crew and an ARV with a 2- or 3-man crew. Although smaller than an M109 section, the AFAS section appropriately would be headed by an E-6 13B30 Section Chief. It appears undesirable to plan on other than an E-6 for the AFAS Section Chief. Considerable experience will be required for the mature judgment essential to this position because the AFAS will operate at a distance from the battery. Therefore, the amount and range of the Section Chief's responsibility will be greater

than it is now while his access to supervision will be substantially less. Although deficiencies in experience level could be overcome through extensive training, a reduction in the grade level of the Section Chief would be inconsistent with the range of skills and decision responsibilities expected for this position.

The organization and grade levels of the remaining personnel in the proposed AFAS section is subject to tradeoffs and depend on how the AFAS positions will be configured. Three functions on board the howitzer would have to be staffed during a fire mission: the gunner who also could serve as the radio operator, the driver who would have to be in position to facilitate rapid displacement, and the loader who at a minimum would select rounds for the loader-assist equipment.

The Section Chief, 13B30, appropriately could serve as gunner and radio operator. The loader, as in a current M109 section, appropriately could be an E-3 13B10. The driver, however, should be an E-5 13B20 instead of an E-4 13B10. While his usual duties will not require additional maturity and training, he may have to substitute for the Section Chief or serve as assistant gunner whenever the cannon had to be operated in manual mode. Grade levels for the ARV crew would depend heavily on whether any rotation between the howitzer and ARV crews was planned.

Recommendations

1. The 3-man howitzer crew proposed by the AFAS Use Study and O&O is feasible if likely crew fatigue during loading could be relieved through robotic loader-assist equipment and if transfer equipment or additional support personnel will be available when receiving or turning in ammunition. Robotic loader-assist equipment also may allow the AFAS howitzer crew to achieve a very high burst rate, and eliminate the need for an additional cannoneer now required to prevent the fatigue that otherwise could severely impair the section's ability to continue firing.

2. Cross training must be an integral part of AFAS unit training and transition training. To maintain the section's capability to continue operating under any type of degraded mode, every crew member should learn the duties of every other to the extent possible, including some duties of the Section Chief.

3. The suggested position configuration and grade level for positions on board the AFAS are Section Chief-Gunner, E-6; Driver-Assistant Gunner, E-4; and Cannoneer, E-3. The composition of the ARV crew will depend on whether that crew is expected to rotate with the howitzer crew.

4. The AFAS Section Chief must be given the authority to act in place of an officer in certain situations. For example, the Technical Manual currently requires an officer to supervise extraction of a projectile stuck in the cannon. This responsibility should be delegable, as courier duties for special weapons currently can be delegated to an E-6 under emergency circumstances.